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Small Stream Surveys for Public Sponsored Habitat Improvement and Enhancement Projects

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SMALL STREAM SURVEYS FOR PUBLIC SPONSORED HABITAT IMPROVEMENT AND ENHANCEMENT PROJECTS

by

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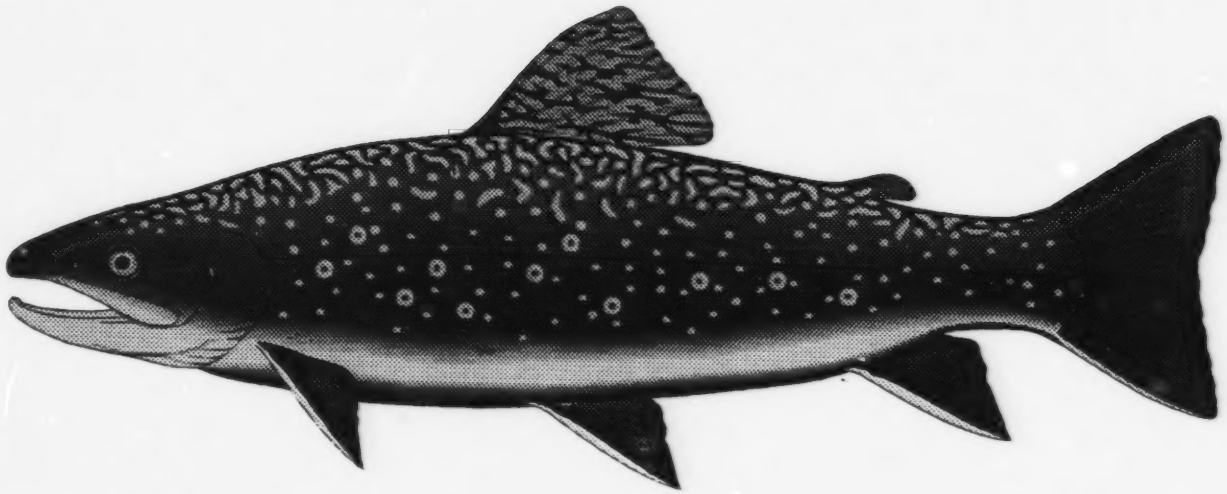

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ABSTRACT

Scruton, D.A., T.C. Anderson, C.E. Bourgeois, and J.P. O'Brien. 1992. Small Stream Surveys for Public Sponsored Habitat Improvement and Enhancement Projects. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 2163: v + 49 p.

This report presents a systematic approach to conducting a survey of a small stream as a prelude to, or component of, a habitat improvement or enhancement project. This approach has been developed for use by public interest groups, development associations, fish and wildlife groups, and other organizations with limited experience in stream survey methods. The report discusses the planning required to implement a survey, the methods and materials required, and necessity for data compilation and reporting. A standard stream survey form, with detailed instructions, and a set of summary tables for compiling information, are also provided.

RÉSUMÉ

Scruton, D.A., T.C. Anderson, C.E. Bourgeois, and J.P. O'Brien. 1992. Small Stream Surveys for Public Sponsored Habitat Improvement and Enhancement Projects. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 2163: v + 49 p.

Ce rapport présente une approche systématique à la réalisation du relevé d'un petit cours d'eau, soit préliminaire, soit concurrant à des travaux d'amélioration ou de mise en valeur de l'habitat. L.approche a été conçue pour l'usage de groupes de défense de l'intérèt publique, d'associations de développment, d'agences intéressées de la pêche et a la faune et de tout autre organisation peu familière avec les méthods de relevé d'un cours d'eau. Le rapport aborde la planification, les méthods et les matériaux requis pour la réalisation d'un relevé, ainsi que la nécessité de compiler et de transmettre les données recueillies. Il fournit aussi une formule-type de relevé d'un cours d'eau avec instructions détaillées, ainsi qu'une série de tableaux où compiler les renseignements.

PREFACE

This publication is intended for public interest groups, development associations, fish and wildlife groups, and other organizations who intend to undertake surveys of small streams as a prelude to, or as part of, a habitat improvement or enhancement project. A general approach to planning, conducting, and reporting a stream survey is presented. This general approach is developed to collect a variety of data that will describe and, to an extent, quantify stream habitat, with emphasis on freshwater fish (salmon and trout) resources in Newfoundland and Labrador. Data collected during the survey will provide information to evaluate the habitats for the possible need and opportunities for improvement and to evaluate the system for its enhancement potential. This general approach can be modified, if required, for a specific project and several of the survey parameters have been identified as optional, depending on the objectives of the survey program. Additionally, this general approach is presented so that information collected from a variety of projects and by different organizations is comparable and in the same format. This will facilitate comparative evaluation of projects and computer storage of, and development of a database for, inventory data as it becomes available.

This report is intended for groups or individuals with limited experience in stream surveys and the collection of aquatic habitat data. Groups intending to undertake a stream survey are strongly encouraged to contact Fisheries and Oceans (see Appendix 3) to discuss their project to obtain advice on planning and conducting the survey. Fisheries and Oceans will also attempt to provide on site training, advice, and support, whenever possible to groups undertaking large stream survey/improvement/enhancement projects. Additionally, for groups who may wish to undertake a more scientifically rigorous survey or who may want to incorporate a research or evaluation component in to their project, DFO staff can provide advice in these areas as well.

INTRODUCTION

Interest in the natural environment has increased recently and people are becoming more aware of the natural resources around them and the need to conserve them. There are increasingly more requests by various agencies, associations, and the general public to become involved in improvement of fish habitat and enhancement of fish stocks. The aim and objectives of these projects varies; many are very simple in nature and have generic goals such as 'improve the environment' while others may be quite specific and propose to remove a certain barrier to fish migration, restore or stabilize a certain section of streambank, or colonize a previously uninhabited stretch of river with salmon, etc. These proposals come under review by various agencies and all existing information on the particular stream is examined and, if possible, a decision is made on the suitability of the project.

In the vast number of cases, when proposals are reviewed by the Department of Fisheries and Oceans (DFO) staff, there is insufficient information available to allow reviewers to make a clear decision concerning whether the project should be implemented or what benefits may be derived. Therefore, the first step in project planning and development is often the completion of a thorough, accurate, detailed survey of the stream or section of stream for which the project is intended. Such a survey, when conducted properly, will serve as the foundation for future improvement/enhancement activities and the results can be used by project sponsors during their efforts to acquire funding for future activities. This information will also contribute incrementally to a data base for fish habitat for which future users can also benefit.

A thorough, accurate, well conducted stream survey provides the following information:

1. the amount of habitat, both accessible and inaccessible, to migrating fishes which is available for fish production;

2. the distribution and proportion of habitat types throughout a watershed including the key habitat attributes that determine habitat types (eg. substrate type, water depths and velocities, etc.);

3. the location and physical description of any barriers to migrating fish using the habitat;

4. the location, types and amounts of stream side vegetation and the stability of stream banks;

5. the location and description of areas where habitat has been degraded or destroyed; and

6. the accessibility of the watershed if future work is proposed.

The following report provides a detailed description on materials and equipment required to conduct a stream survey, how it should be planned and conducted and provides a general framework for the compilation and interpretation of the results. Although the techniques used in stream surveys are fairly simple it must be stressed that, for the survey to be of any value, it must be conducted in a consistent, accurate manner throughout.

PLANNING

It is extremely important to plan a stream survey well in advance of going into the field to collect the detailed information. This will permit the survey to be conducted in an organized and efficient manner and will allow the sponsor to deploy available human and monetary resources to the maximum benefit of the project. This will also allow for efficient use of days when inclement weather will nor permit surveying and will ensure that the project sponsor has allowed sufficient time to complete all aspects of the program.

Early in the planning stages it is useful to get a map of the stream to be surveyed to determine the overall scope of the project and assist in identifying the overall project approach. These maps can be either topographic maps (1:50,000 scale) available from the Provincial government (Department of Forestry and Agriculture, Howley Building, St. John's), forest inventory maps (often available at finer scales, eg. 1:10,000 or less), or other maps provided by other agencies (eg. municipal and regional maps for development, etc.) that may provide more detail and locally relevant information. These maps will be used, in the first instance, to determine the general approach to the survey; i.e. the starting points, how many kilometres of stream can be surveyed in a day, the access points and how and when people will be moved to and from the survey points, scheduling of the project, the amount of stream that can be surveyed with available resources, etc.

In the planning stage, it is also necessary to identify any tributaries (smaller streams flowing into main rivers) that will be surveyed and provide a logical numbering/lettering scheme to identify each major stream (if unnamed), or 'tributaries' to these tributaries. This will allow for a logical assignment of an 'identifer' to each tributary so that each subsidiary stream can be readily located rather than have the field crews arbitrarily assign a designation when in the field. This will reduce confusion and make the task of compiling the field data simpler when the survey is complete. This is also critical if 2 or more survey crews are working on the same watershed and will avoid duplication of tributary assignments. The most standard approach, and one that is recommended by DFO, is to start at the mouth of the stream being surveyed and

assign tributary numbers in an upstream direction (eg. T1, T2, T3, etc; see Figure 1). The same approach can be adopted for each sub-tributary, that is the first sub-tributary of T1 would be designated T1-1, and so on. This approach can be adopted for the entire hierarchy of streams (see Figure 1) so that a logical approach to the designation of tributary identifiers is done, and this will facilitate the development and use of a computerized data base, and will benefit future users of the data.

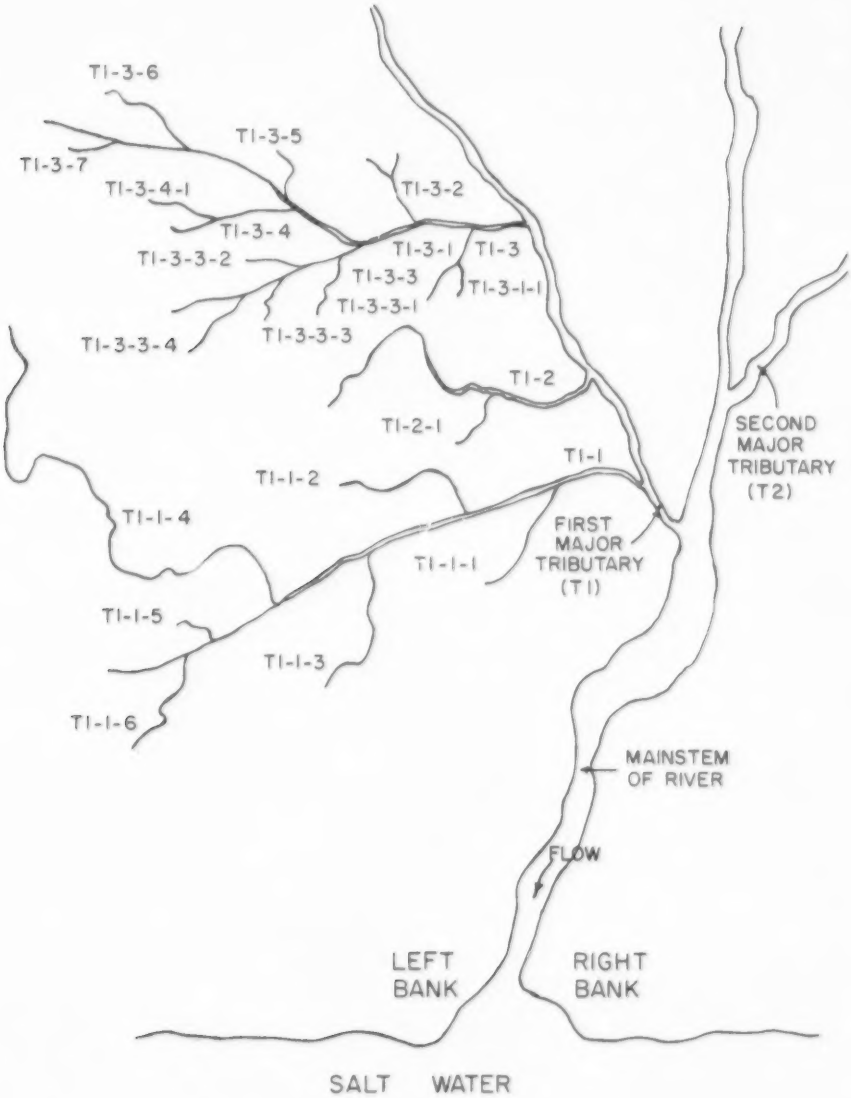

Figure 1. An example of an approach to assigning tributary numbers within a large drainage river.

Depending upon the size of the stream that is being surveyed, the amount of time and available funds to conduct the survey, and the number of people employed to conduct the program it may be appropriate to divide the group into 2 or more crews. Survey crews usually involve a minimum of 3 individuals; 2 individuals to collect the measurements and one to record the information. If two or more survey crews are working on the same river it is strongly recommended that all crews work together for a minimum of 1 day to ensure all methods and interpretation of data are comparable, prior to dividing into smaller crews. It would also be advisable to review data sheets between survey crews, as they are completed, to ensure consistency in collection of information and in emphasis on components of the survey.

Stream surveys are usually, but not always, conducted from the mouth in an upstream direction. This is so tributaries are readily identifiable and can be associated with a pre-assigned numbering scheme. Additionally, by walking upstream, it ensures that debris and silt stirred up from walking in and across the stream will not obscure the visibility of the habitat being surveyed (i.e. the silt and debris will always be carried downstream away from the direction of the survey). If starting points are not the river mouth, or not at the lowest extent of the section undergoing survey, or conversely crews are completing different stretches of the same stream, it is important to pre-assign section numbers (eg. crew 1 will start at the mouth and number from 1 -110, crew 2 will start at a predesignated point and use section numbers from 200 on, etc.) to avoid confusion and/or overlap. It will be extremely important to document any numbering scheme in a final report and on map products used so all data can be clearly linked to a section of stream.

It is also important to try to conduct the survey during periods of similar flow conditions as collecting information under widely variable conditions will make data comparability difficult. Generally, surveys are normally conducted in the summer months during the drier, hotter part of the year. This is the time of year when stream widths and depths are at their annual lows and measurements would reflect minimum values. This is also the time of year when habitat variables would be most limiting and measurements would be most representative of available habitat. This is also the time period when streams are usually wadable, substrate can be readily classified, and instream features are easily discernable. If surveys are conducted at other times of year, or under higher flow conditions, then it is often useful to collect, as a minimum, width and depth measurements during summer low flows for comparison. Similarly, if a survey is to be conducted over a lengthy time period it is best to conduct the survey only on days when flows are constant and not, for example, after a period of heavy rain (spate). If there is a period of heavy rain that produces a considerable change in the discharge or flow of the river it is often advisable to delay future surveying until the flows have subsided. It is also extremely important not to have crews conducting surveys under dangerous conditions.

MATERIALS and EQUIPMENT

Stream surveys as outlined in this report require no specific scientific instruments or expensive equipment, however, a list of items that will be required throughout the survey period is provided below:

1. map(s) (scale 1:50,000 or more detailed)
2. 50 or 100 m measuring tape (preferably cloth or plastic tape)
3. meter stick(s)
4. stream survey instructions (this report)
5. stream survey sheets (see Appendix 1)
6. waterproof notebook, pencils, clipboard (weatherproof if possible)
7. camera, film
8. stopwatch, floating ball
9. thermometer (if available)
10. rain gear
11. fly repellent
12. waders (hip boots and possibly chest waders for deep stretches)
13. first aid kit
14. change of clothing, footwear
15. emergency rations
16. compass

It should be noted that the map forms the basis for planning the survey and should serve as a 'directory' that can show the location of all the sections surveyed, obstructions to fish passage, habitat damage, etc. As this map is important, it is often advisable to have a duplicate and transfer information from any map used in the field survey to a second map that is maintained at another location. Also, those involved in the survey should ensure that all data are protected from the rain and wind as much as possible. Field crews should check the data sheets at the completion of each section and at the end of each day to ensure they have been completed properly and, if sheets have been affected by weather, information should be copied onto clean, dry forms. If the sponsoring agency is using a computerized data base (DFO may develop a relational data base if there is sufficient need) the data can be entered and checked at periodic intervals or during periods of inclement weather.

INSTRUCTIONS

The following section contains detailed instructions to accompany the stream survey form contained in Appendix 1. A number of components of the stream survey are considered optional and can be included as part of the overall stream survey at the discretion of the group/agency undertaking the project. These items are identified with an asterisk (*) in the following instructions. The remaining components are considered essential to a detailed stream survey and it is recommended that any group/agency undertaking a stream survey should endeavour to include these items whenever possible. It is also important to check the survey sheets at the completion of each station to ensure all desired information has been collected.

For the purposes of convention all designations of stream banks etc. (eg. left hand bank, right hand bank) are with respect to looking and working in an upstream direction.

1. LOCATION AND GENERAL INFORMATION

Stream Name (Number) - Use the proper name of the stream or river as obtained from topographic maps or from the Newfoundland Gazetteer. Try not to use local names if possible. If the survey is extensive and will include many tributaries and sub-tributaries, a numbering or coding scheme may need to be employed. This scheme should be worked out logically and prior to implementing the field program (see PLANNING).

***River Code** - This is a 7 digit code, the Waldron's River Code (Waldron 1974), used by the Department of Fisheries and Oceans. If unsure of the proper code, contact the local Area Habitat Coordinator (see Appendix 3) or leave until later.

Tributary of - If the stream being surveyed is a tributary of a larger system, indicate which river. If the system being surveyed is its own distinct drainage unto itself, and you are surveying the main stem, then leave blank.

***Map Reference** - Provide the name or number of any map being used in conjunction with the survey. This could be a 1:50,000 scale topographic map (eg. 12A/16 or Badger) or any other maps (eg. Newfoundland Department of Forestry and Agriculture 1:10,000 scale maps). This information is optional or could be added later.

Tributary Number - Assign the appropriate tributary number to designate the section of stream being surveyed, as needed. Pay particular attention to an appropriate numbering scheme for the designation of tributaries (see PLANNING).

Section Number - Number consecutively for each river, tributary, or sub-tributary. An appropriate scheme for numbering sections should also be considered during planning. This number should coincide to distinct location on an overview map of the stream (see PLANNING).

***Stream order** - Indicate the drainage order of the stream being surveyed. Stream order is a measure of the position of a stream in the hierarchy of tributaries. A headwater stream has no other tributaries and is considered a first order (1) stream. A second order (2) stream has a first order tributary draining to it while a third order (3) stream has a second order stream draining into it, etc. An example of stream ordering is presented below. This information may be added after completing the survey, or if unsure of the stream order, could be omitted.

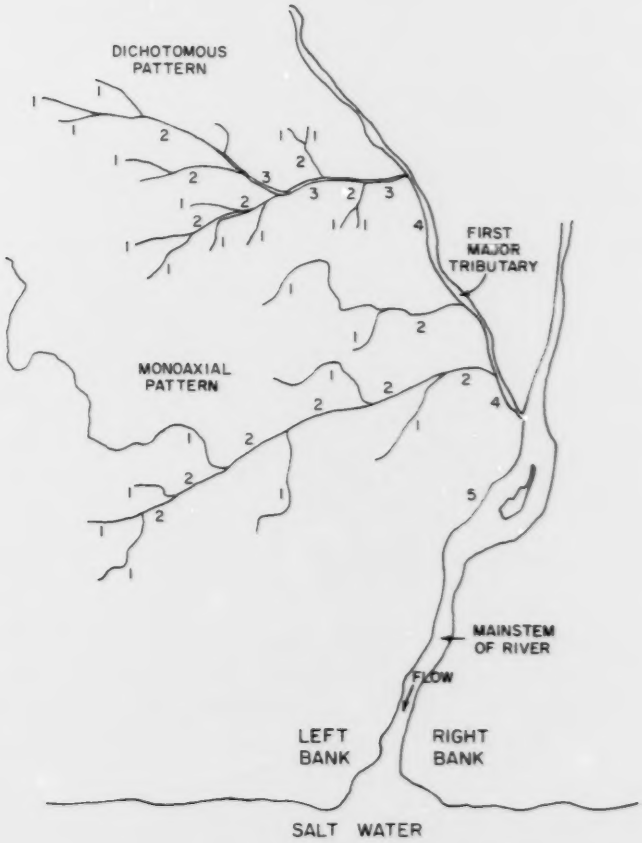

Figure 2. An example of a stream ordering system.

Date - The date of the survey in year-month-day [eg. 1990-06(or June)-22].

Field Crew - The names of the individuals conducting the survey or, at the least, the individual in charge of the survey crew. This will provide a contact should any questions or uncertainties arise from the survey data.

***Coordinates** - Provide the approximate coordinates of the stream section either in latitude and longitude (eg. 46°32'33" N, 55°45'21" W) or in UTM coordinates (eg. 588967 northing, 38165 easting). This information could be considered optional or could be added later (in fact, the coordinates would need to be obtained from a map). It is therefor important to ensure that the stream section location is identified on a field map. The addition of this information is extremely important to the potential future use of this data, and geo-referencing will be required if the data is to be used in computerized mapping and analyses packages such as a GIS (Geographic Information System).

***Weather** - a general description of the weather.

Time of Day - Indicate the time of day approximately at which time the section is being surveyed in a 24 hour clock (eg. 9:00 a.m is 09:00 and 2:30 p.m. is 14:30).

Description - Provide a very general description of the site (see Appendix 3 as an example).

***Comments** - Provide any general comments or observations in association with the site. For example, any observations on fish species and sizes, wildlife and birds observed, site access, etc., is useful. Any knowledge of the biological history of the system could be included in this section. This is optional.

2. SECTION CHARACTERISTICS (GENERAL)

Section length (m) - Measure the length of the section being surveyed in meters (to the nearest 0.1 m), preferably with a measuring tape or by pacing. The length should, wherever possible, not exceed 100 m (see PLANNING).

Water Level - Indicate whether the water level of the stream is low, moderate or high. This is done by observation and from experience with the system. If unsure leave blank or water level can be inferred from Environment Canada water survey records (i.e. at a later date).

***Water Temp. (^{0}C)** - Measure the water temperature in degrees celsius to the nearest degree. This is optional depending on the availability of a thermometer. The bulb of the thermometer should be in the water for a minimum of 30 seconds.

***Air Temp. (^{0}C)** - Measure the air temperature in degrees celsius to the nearest degree. This is optional depending on the availability of a thermometer.

Water Sample (y/n) - Indicate whether a water sample was/was not collected for chemical analyses. A water sample is not recommended for every section but several water samples at various locations in the watershed would help describe the chemical characteristics of the watershed being surveyed. Groups should consider the costs of water analyses and proper collection, handling and storage procedures prior to collection (Environment Canada 1983). It is recommended that DFO or a water quality laboratory be contacted for this information prior to any field program.

Photos (y/n) - Indicate whether photographs were/were not taken. It is highly recommended that one photo of each section be taken and photographs of each barrier and other unique features also be collected. A separate photo log describing the content of each photograph would also be of benefit.

Roll# - If photographs were taken indicate which roll of film the pictures are on.

Exposures - If photographs were taken indicate which exposures on the roll of film contain photographs from the section being surveyed.

Width (m) - Take the three wetted width (start, middle, end) measurements from the cross sections and average (add together and divide by the number of measurements) to get the mean (to the nearest 0.1 m for small streams).

***Surface Velocity ($m.s^{-1}$)** - Velocity is a measure of speed of water at a location in the water column, in this case the surface, in meters per second. Drop a floating object in the main current of the stream and determine the length of time it takes to float a predetermined distance (eg. 10 meters). Divide by the distance to get the velocity in meters per second. Take several measurements (usually 3). Determine the mean by adding the measurements together and dividing by the number of measurements. Be sure to set up the area for velocity determination in an area where back eddies or debris will not affect the measurement.

3. CROSS SECTIONS

It is recommended that at least three cross sections be taken per section, assuming the stream is wadable and the survey crew has a measuring tape and meter stick. A cross section should be taken at the Start (top) of the section, in the Middle, and at the End (bottom). If the stream is surveyed with consecutive sections there is no need to repeat the Start cross section as it will be the same as the End cross section of the previous section (if this is the case simply check the appropriate spot on the survey form). For each cross section collect the following:

Location (m from start of section) - Indicate the location of the cross section in meters (to 0.1 meters in small streams) from the start of the section. For 100 meter sections, this will be 0 m (Start), 50 m (Middle) and 100 m (End).

Channel Width (m) - Measure the channel width, that is distance from the bank full height on one bank to the bank full height of the opposite bank (see below). Measure to the nearest 0.1 meter on small streams.

Wetted Width (m) - Measure the distance from the waters edge on one bank to the waters edge on the opposite bank (see below). Measure to the nearest 0.1 meters on small streams. For streams with multiple channels, note this feature and measure each channel and add for the total wetted width.

Depth (m) - measure the depth in centimetres using a meter stick at distances of 1/4, 1/2, and 3/4 of the wetted width of the stream. On wider streams, more measurements may be appropriate. Calculate the mean depth by summing the individual measurements and dividing by the number of measurements **plus 1**.

Bank Height (m) - Measure or estimate the height of the bank (the height from the waters edge to the top of the bank) in meters (to the nearest 0.1 meter on small streams).

Maximum Flood Height (m) - Measure or estimate the maximum flood height (to the nearest 0.1 meter on small streams), as an indicator of the range in discharge for the stream, from either of three indicators (measurements). This can be inferred from either (1) ice scour mark on the stream bank or on the vegetation along the stream edge, (2) debris in vegetation along the stream edge or (3) from stain marks or from lichen growth on rocks.

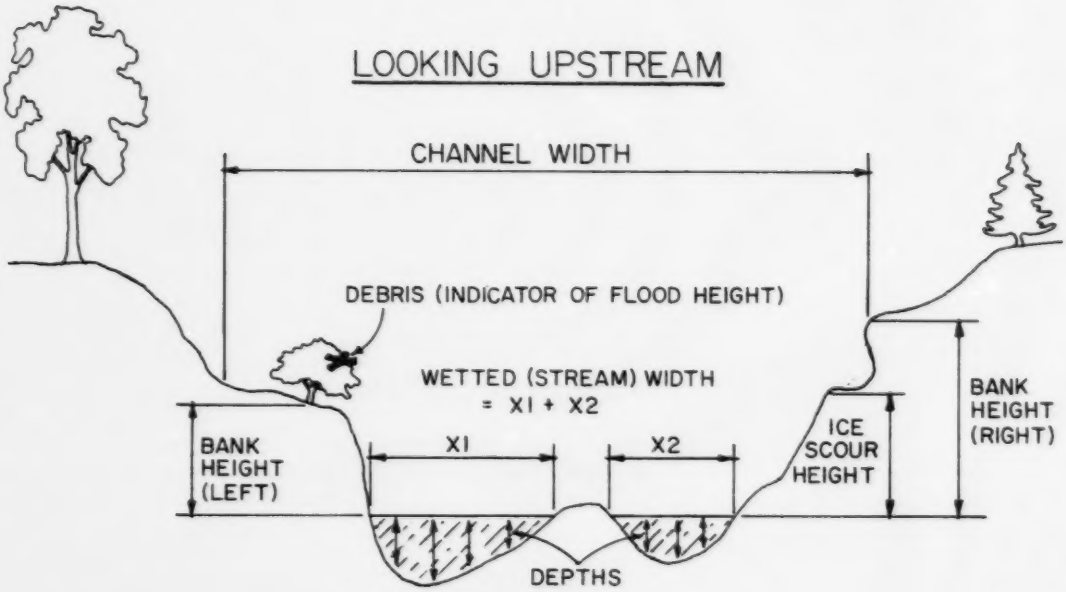

Figure 3. Measurements taken across a stream cross section (looking upstream).

4. HABITAT CHARACTERISTICS (GENERAL)

Stream habitat is best described by quantifying the various types including pools, riffles, runs, steadies or flats, rapids, etc. The basic differentiating characteristics of these habitat types are listed below. Provide an estimate of the proportion of each habitat type within the section as a percent. The best way to become familiar with these habitat types is to conduct a portion of the survey with an experienced individual who can point out the 'field' distinctions between habitat types.

Pools - area of river that is wider, deeper and slower than the average river/stream. Bottom is often comprised of silt, debris, sand, etc. Pools tend to be discrete areas within a river stretch rather than be a characteristic of an entire stretch (i.e. pools are often associated with riffle stretches).

Riffles - areas usually characterized by shallow water (mean depth < 25 cm) with average to rapid current, and a broken or occasionally turbulent flow. Substrate is usually comprised of gravels through boulders and normally contains less silt than other slower water areas.

Runs - areas of swift, deep (mean depth > 25 cm), and flowing water and water surface is often broken with turbulent flows. Runs tend to be less than the average stream width. Often characterized by boulder/rubble substrate.

Steadies or **Flats** - areas characterized by lower water velocities and water surface is usually smooth, stream width and depth is often wider than average, substrate is often featureless comprised of rock, silt, sand, etc. Flats are usually smaller areas within a stream section with depth less than 50 cm. Steadies are more extensive and can be many sections in length and can be deeper than flats. Flats and steadies are usually associated with river stretches of low gradient. Identify the section as **either** a steady or flat.

Rapids - areas of steeper gradient with irregular and rapid flows often with turbulent white water, substrate is usually comprised of larger rubble, boulder, and bedrock (larger than average substrate for stream). Rapids are primarily associated with larger stream sections and rivers. In larger rivers it is recommended that the survey crew not attempt to conduct cross sections in these types of habitat.

Others - include types such as falls, cascades, or ponds.

5. POOL CHARACTERISTICS

Number of pools - Total the number of pools in the section.

Pool/riffle ratio - Estimate the relative proportion of pool to riffle habitat (from the estimates of % pool and riffle habitat in previous Part 4). This can be completed during or after the survey.

For each recognizable pool in the section provide an estimate of the length and width in meters (to the nearest 0.1 meter in small streams) and depth in centimetres.

Comments - Provide any comments that can further describe the quantity and quality of pool habitat in the section. For example 'Section contains one large and 4 smaller pools' or 'One extremely large pool with undercut bank and good overhanging vegetation at lower bend in section'. It is also useful to locate the pools on a sketch of the section (see Part 12).

6. SUBSTRATE

Provide an estimate of the proportion (as a percent) of each of the substrate types listed below. Ensure that the sum of the substrate types totals 100%. It is often best to conduct 2 independent estimates of the substrate and compare. Substrates are classified according to size as per the following:

Bedrock - Continuous solid rock exposed by the scouring forces of the river/stream.

Large Boulder - Large boulder sized rocks greater than 1 meter (38 inches) in diameter.

Small Boulder - Boulder sized rocks from 25 centimetres to 1 meter (10 to 28 inches) in diameter.

Rubble - Large rocks from 14 to 25 centimetres (5.5 to 10 inches) in diameter.

Cobble - Moderate to small sized rocks from 6 to 13 centimetres (2.5 to 5 inches) in diameter.

Pebble - Small rocks to stones from 3 to 5 centimetres (1 to 2 inches) in diameter.

Gravel - Small stones from 20 millimetres to 3 centimetres (0.1 to 1 inch) in diameter.

Sand - Sand sized deposits frequently found on margins of streams or between rocks and stones, from 0.06 to 20 millimetres in diameter (less than 0.1 inch).

Mud or Clay - Very fine deposits from mud to silt on stream margins, between rocks, and on top of other substrates.

Degree of Siltation - Describe the relative degree of siltation in the section. Determine if there is much silt deposit on top of and between other substrate rocks. This could be either descriptive or defined as a percentage of the substrate covered by silt and to what depth.

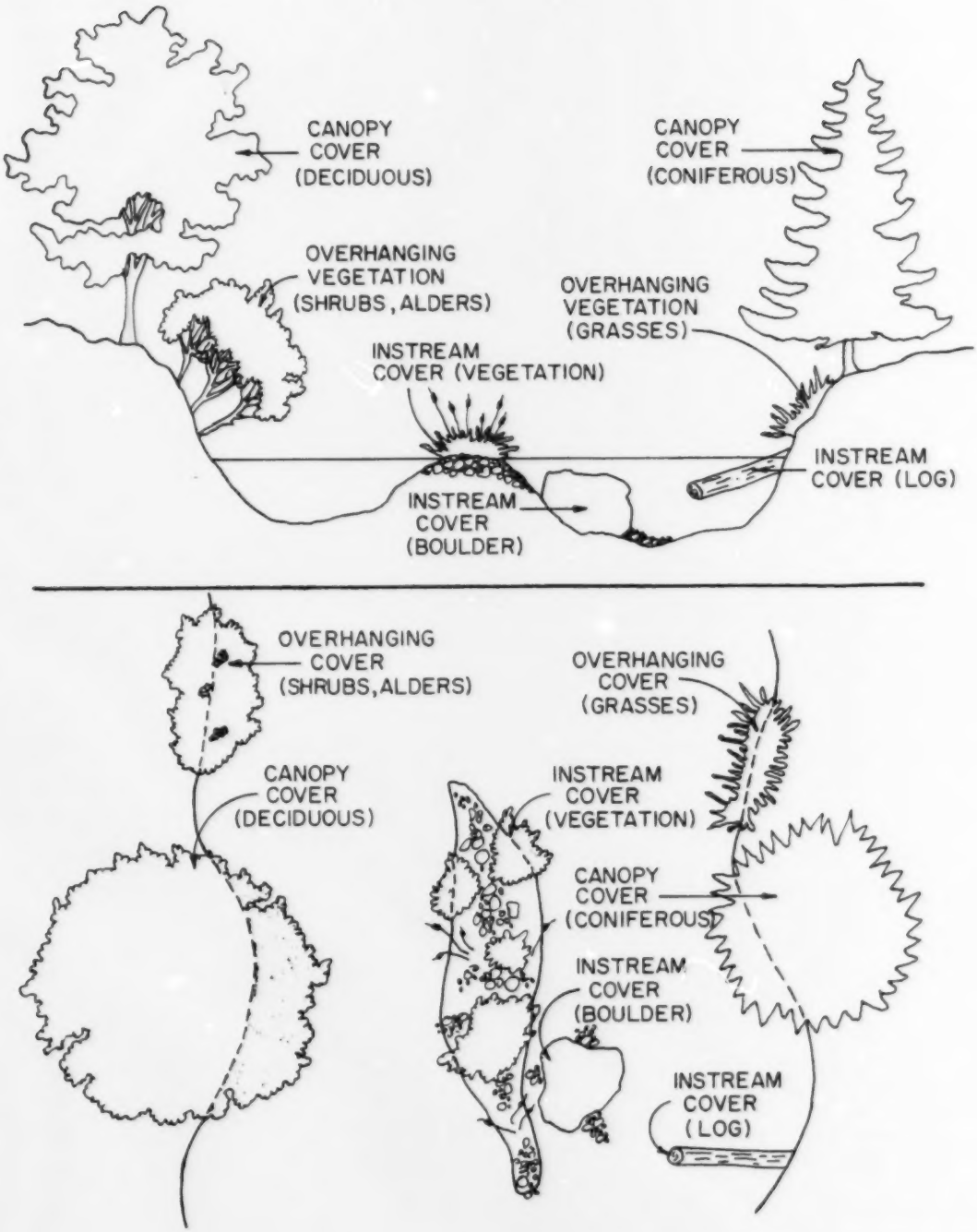

Figure 4. An example of the cover types available to fish in the stream environment, including how to evaluate the precentage of canopy cover.

7. COVER

The types of cover available to fish, either for hiding areas or to provide shade, can be divided into three types; overhanging, instream, and canopy cover. Instream cover can be broken into that provided by vegetation or that provided by large rocks/boulders, logs, and other debris (see Figure 4). Estimate the relative proportion of each cover type as a percent of the section.

The cover types are defined as follows:

Overhanging - Cover provided by grasses and shrubs along the sides of a stream. This vegetation is along the stream edge or hangs out over the stream and includes all grasses and shrubs up to about 1 meter in height. Alders are a common type of overhanging cover on small Newfoundland streams.

Instream (substrate, logs, debris, etc) - Cover actually in the stream bed as provided by fallen trees and logs, larger rocks and boulders, accumulated debris, etc. This can also include undercut banks.

Instream (vegetation) - Cover in the stream bed as provided by live aquatic vegetation including grasses (often flooded), macrophytes, water weeds, mosses, algae, and other plants that can grow in streams. Slow water areas (steadies and flats) may contain water lilies, etc.

Canopy - Cover provided by mature hardwood and softwood trees along the sides of a stream. Include in the estimate only the tree that actually have their branches/foliage hanging over the stream.

8. RIPARIAN VEGETATION

Estimate, as a percent of the surrounding vegetation within about a 5 meter distance from both stream banks, each of the following types of vegetation:

Vegetation:

Hardwood - mature deciduous (trees that lose their leaves in the fall/winter) trees. Includes maples, birch, etc.

Softwood - mature coniferous (trees that maintain their foliage all year round) trees. Includes spruce, fir, pine, etc., and also juniper (tamarack).

Alders, etc - includes all larger, hardwood shrubs such as mountain ash (dogwood), willow, aspen, etc. up to 2 meters in height.

Shrubs - includes smaller, and softwood shrubs, not included above. This would include Labrador tea, blueberry, fireweed, ferns, etc.

Grasses - all natural grasses on the stream edge and in association with surrounding vegetation.

Bog - all surrounding wetland including bogs and fens.

Stream bank:

Indicate the presence of stream bank erosion (y/n) and estimate the percent of bank erosion within the stretch. Remember that if one bank only is eroded for the entire section the amount of erosion in the site is 50% (the other bank, or 50%, is not eroded at all). Bank erosion is indicated by the absence of vegetation along the bank and evidence of soils, debris, etc. slumping into the river. Bank scour from ice and high water is evidence of some small erosion.

Rate the stability of the bank as good, fair, and poor. Good bank stabilization indicates that more than 80% of the stream bank is stable and well vegetated. Fair or moderate stability is indicated by from 50 to 80% stable banks with minimal evidence of erosion. Poor bank stability is indicated by less than 50% stable banks and considerable evidence of erosion.

Indicate the presence and amount of undercut banks (y/n), that is the stream has actually cut into the stream edge and formed a wetted area under the stream bank. These areas are excellent habitat for salmon and trout and should be noted. Indicate the percent of undercut bank on each of the left and right hand banks (facing upstream). Include location and extent (horizontal distance) of undercut banks on the section drawing (see Section 12).

9. OBSTRUCTIONS

Indicate the presence (y/n) of obstructions in the stream section, that is areas that may be potential barriers to the movement of juvenile and adult fish. These obstructions can be natural (eg. debris blockage, falls, etc.) or man made (eg. culverts, log and concrete dams, collapsed bridges, etc.). Water speed can also be barriers (velocity barriers). The speed of the water at a site, due to constriction or some other reason, may be too great for fish to swim against and therefor they cannot pass the site. This is extremely difficult to determine and if a velocity barrier is suspected it is recommended that it be noted only and professional staff will

attempt to investigate the situation. It is extremely important to document all obstructions as they can severely limit the enhancement/improvement potential of a stream and conversely obstruction removal can be a very cost effective and efficient means of increasing available fish habitat. The survey crew should attempt to describe in detail all obstructions (below) and must photograph each barrier. Include some means of measuring the barrier height, i.e. have someone stand beside the barrier in a photograph.

Type/number - indicate the type of the barrier, i.e. dam, debris jam, culvert, log jam, beaver dam, falls, rapids, etc. If there are more than one barrier in the section provide details on each. For each barrier in the section provide the following:

> **Vertical height** - estimate or measure the height of the barrier, from the water surface at the bottom of the barrier to the top of the falls, debris etc., in meters. See below.
>
> **Slope** - estimate the slope of the barrier in degrees, that is the angle from the bottom of the barrier to the top. A straight vertical drop has an angle of 90^0. This is used mostly for falls. See below.
>
> **Width** - estimate or measure the width of the barrier in meters (0.1 meter on small streams). See below.
>
> **Length** - estimate or measure the length of the barrier in meters (0.1 meter on small streams). See below.

Comments - provide any additional comments that could help to describe the barrier. Comments could also be made as to the desirability and difficulty of removing the barrier and the need for further investigation.

In addition to photographing the barrier, the obstruction could be sketched and its location included in the schematic drawing of the section (see Section 11).

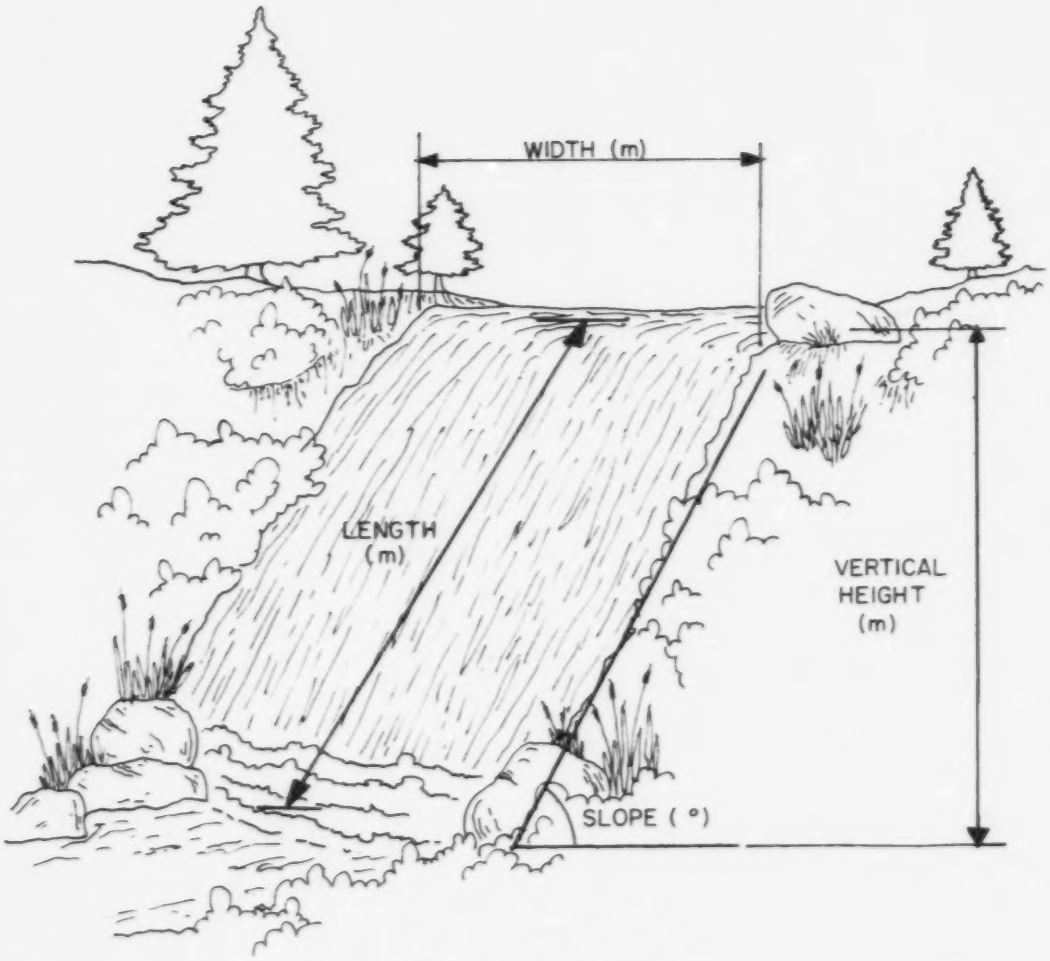

Figure 5. Measurements to collect in relation to a barrier falls.

10. IMPROVEMENT OPPORTUNITIES

Provide any commentary on the potential to improve the habitat in the section surveyed. This does not need to be completed for all sections and, in natural streams, there may be no need to consider improvement. In impacted or degraded streams more attention should be paid to completing this section. Comments could include the desirability for obstruction removal, the need for bank stabilization, or the need to create pools and other habitat features (undercut banks, riparian vegetation, provision of suitable substrate, etc.). Field crews conducting stream surveys with the purpose of identifying habitat improvement opportunities should familiarize themselves with Buchanan et al. (1989) and other reports identified in the REFERENCES and SUGGESTED READING section (p. 29) prior to conducting the survey.

11. SCHEMATIC SKETCH or DRAWING

It is desirable, but not essential; to include a diagram or drawing of each section surveyed. This is not intended to be an artists rendering but a general schematic sketch of the section identifying key features and locations of measurements. An example is presented below. The sketch could included location of pools, undercut and eroding banks, obstructions, springs, tributaries, instream debris, potential spawning areas, islands and gravel bars, distribution of key habitat types, areas with heavy siltation, sewer outfalls, culverts, etc. It is also important not to 'clutter' the diagram so it is interpretable at a later date.

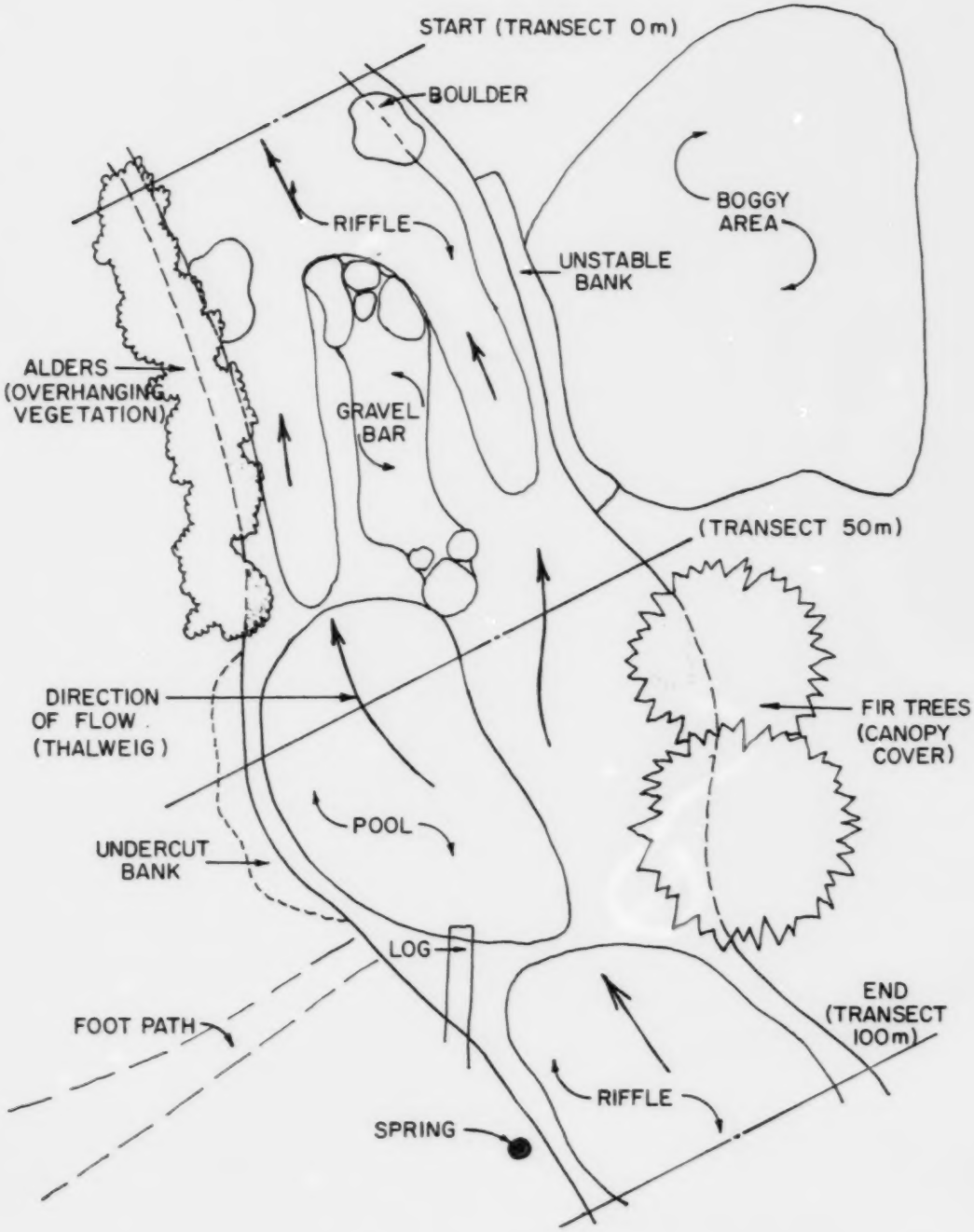

Figure 6. An example of a schematic drawing of a stream section.

DATA COMPILATION and REPORTING

In order to be meaningful, stream survey data must be collected, recorded, and compiled in a consistent and accurate manner. The preceding sections have outlined the procedures for accurately collecting data and a standardized form used to record the data is found in Appendix 1. Effort should be made to complete each form as completely as possible. Forms that are found sometime in the future that are incomplete, ie. that have no river name, section number, etc., are of virtually no value. Once forms are completed in the field it is highly recommended that they be checked at the end of each survey day to ensure they are complete in every detail. Ideally, all survey forms should be photocopied and the original should be filed in a safe location (not the same location as the copy!). All photographs should also be duplicated and clearly labelled on the back. Summary tables, such as those presented in Appendix 2 as examples, can be started during periods of inclement weather and can then be completed at the end of the survey.

It is hoped that a relational data base can be developed to accompany this stream survey approach, depending on the future requirements as identified by potential users. This type of electronic data base could assist sponsoring groups in computerizing their data; summarizing, interpreting, and reporting the appropriate information; and assist with displaying the information on maps, figures, etc. This computerized information could then be submitted to DFO who would then start to build a comprehensive data base with information collected from other sponsors using the same standards and approaches. This information could then become available for a wider spectrum of potential users.

Properly completed summary tables, based on accurately collected data, will provide information on what future remedial activities may be required on a watershed and what opportunities exist for stock enhancement and habitat improvement. If angling information indicates fewer numbers of fish, this may be able to be connected to improperly installed culverts, eroding streambanks, or degradation (siltation) of spawning gravels. With respect to Atlantic salmon, the amount of juvenile fish rearing habitat can be used to estimate the potential production of adult salmon. If angling data indicate the production of salmon is below the potential, there may be an opportunity for enhancement activities. Stream survey information will help establish priorities for remedial activities in the watershed and contribute to establishing the cost-benefit of proposed undertakings.

The results of a stream survey should be reported in a year end project summary report. Such a report should include, but not be limited, to the following:

INTRODUCTION - includes general information on the reason for the project, how it was initiated, what the major goals are, funding sources, participating agencies, etc.;

MATERIALS AND METHODS - includes a detailed list of materials used and describes the exact methods employed to collect the data. Any deviations from the recommended methods identified in this report should be clearly identified. Approaches to distinguishing and uniquely identifying tributaries should be detailed, with accompanying map(s). Any unusual weather or flow conditions taht may have potentially

RESULTS - includes summary tables of various data that were collected and an outline of the progress of the survey. Copies of the survey forms can be provided as a Appendix to the report, or in a separate document or simply delivered to interested parties within DFO;

DISCUSSION - this should include some interpretation of the results and should highlight areas where future work maybe required to increase fish production. Problems related to habitat damage, poor fish passage, pollution, overfishing etc. should be discussed. The discussion should be related to the stated objectives and goals;

RECOMMENDATIONS - includes a list of recommendations for future work based on the results and discussion;

SUMMARY - a brief summary should detail whether the project met its goals and should reinforce any recommendations for future actions. This should highlight the objectives, key results, funding sources, and other overview information in a one to two page overview for potential readers who would not read the entire report.

GLOSSARY OF TERMS

ADULT - Life stage of fish where they have matured and are able to spawn (reproduce).

ALGAE - Small microscopic plant life consisting of one celled to many-celled life forms either free floating or benthic (on the bottom of lakes and streams). Algae forms the base of many food chains as many algae are involved in photosynthetic activity. Often found attached to substrate material (rocks, logs, etc.) in streams and lakes.

ANADROMOUS - Fish which spend a portion of their life cycle in both fresh and salt water. These fish reproduce and spend most/all of their juvenile rearing in freshwater and a portion of their adult life cycle at sea (eg. sea-run Atlantic salmon and brook, brown and rainbow trout).

BANK HEIGHT - The vertical distance from the stream edge to the top of the bank adjacent to the stream.

BANK STABILITY - The degree of erosion on the banks of streams as caused by natural forces or by human activity. This can be descriptive or can be determined as a proportion of the stream bank that is stable (i.e. demonstrating no erosion) or, alternatively, unstable.

BRAIDED CHANNEL - Refers to stretch of river that is divided into separate channels which successively meet and divide. Often associated with low gradient stretches or river mouths (deltas). Braided stretches often provide good spawning habitat.

CANOPY COVER - Refers to the cover or shading provided by the foliage and branches of large trees hanging over the stream. Canopy cover is usually expressed as a percentage of the stream that is covered by the foliage of large trees.

CARRYING CAPACITY (PRODUCTIVE CAPACITY) - Refers to the maximum **average** number or weight of a given organism that a stream or river can maintain through natural processes.

CATADROMOUS - Fish which spend a portion of their life cycle in both freshwater and salt water. Catadromous fish reproduce in salt water and their young invade freshwater systems and grow to maturity when the adults return to the salt water to reproduce. An example are eels which travel to the Sargasso Sea for spawning and the young swim or drift back to their continental waters and ascend streams.

CHANNEL SINUOSITY - Refers to the degree of meander or bending of a stream channel and can be quantified as the total channel length over a distance in relation to the minimum distance between these two points.

DEPTH - Refers to the distance from the stream bottom to the water surface. This can be at a specific point or can be averaged for a cross section, stream section or reach, etc.

DISCHARGE (STREAM FLOW) - The rate of flow or the volume of water flowing at a location in the stream in cubic meters per second. Discharge can be instantaneous or averaged daily, monthly, or annually.

ENHANCEMENT - Refers to activities and strategies that are intended to improve the production of fish in a given watershed, section of stream, or, in some instances, a region encompassing several rivers. can include activities such as fry and juvenile stocking and rearing, adult transfers, kelt rejuvenation, stream remedial and obstruction removal, etc.

EROSION - The weathering of streams, rivers and their watersheds by the forces of wind, water, ice, gravity, etc. Also refers to erosion by forces caused by human intervention.

FLATS - Stream habitat that is characterized by water with slight to moderate current with unbroken surface, with less depth than pool habitat and usually wider than the stream average. Substrate is usually comprised of finer materials.

FLOOD PLAIN - The flat region bordering a stream that is subject to frequent, if not annual, flooding during periods of high discharge. Material in this region is usually deposited from sediments transported by the stream at high flows.

FRESHET (SPATE) - A rapid sudden rise in stream discharge and level as a result of heavy rains or, in the winter/spring, as a result of melting snow and ice.

FRY - The life stage of fish, after hatching from the egg, during their first year of life. Newly hatched fish that have not started feeding and are using up their reserves from the yolk sac are referred to as **alevins**.

GRADIENT (SLOPE) - The general slope or vertical drop of a stream per unit of length. Usually measured in meters/kilometre and can be estimated from topographic maps for long stream sections or can be visually estimated or measured, using surveying equipment, for shorter stream sections. Gradient has a relationship to velocity, substrate, depth, width, etc. and will often determine the habitat distribution and presence/absence of barriers.

GROUNDWATER - Water that is found under the earth's surface usually in porous rock, soil, and other cavities.

HABITAT - The total environment (physical, chemical and biological) required by an organism to complete all of its life processes. For fish this includes the requirements for space, food, shelter, reproduction, rearing and nursery area, water quality, etc.

HABITAT IMPROVEMENT - Refers to activities and strategies that are intended to improve the carrying capacity of a stream section for fish production. This can include activities intended to correct problems created as a result of human activity or may be intended to provided habitat features that are limiting the stream potential under natural conditions.

ICE SCOUR - This refers to the scouring of the stream bank, most frequently at the high water mark, as a result of periods of high discharge in the late winter/spring. Floating ice moved under high water conditions causes erosion of the stream bank and leaves a discernable mark. Often used to estimate the range in discharge of a stream (reach).

INSTREAM COVER - Refers to the cover provided for fish from flows, predators, etc. in the wetted reaches of the stream by instream debris (logs, tree roots), undercut banks, large substrate (boulders, rocks, etc.), and instream vegetation. Instream cover is often estimated as a percentage of the stream area of the total of the above cover features.

LARGE ORGANIC DEBRIS - Refers to trees, logs, branches etc. that are present in the stream as a result or erosive forces and, occasionally, human activities (eg. forestry harvesting). This material can provide cover but can also cause jams and barriers to fish migration and act as sediment traps. Provides good material for invertebrate production.

LICHEN - a plant consisting of algae and fungus living in symbiosis on a solid surface such as boulders, bedrock, etc. Can be used to determine the maximum water level or flood height of a river (i.e. there will be limited lichen growth below the permanent high water mark).

MEANDERING - Refers to the bend or sinuosity of a stream channel. The process by which a stream winds or snakes its way across the surrounding terrain often changing its course gradually as a result of erosion and transportation/deposition of sediments and other material.

MACROPHYTES - large (macroscopic) aquatic plants usually associated with low flow, deep areas in a river (flats and steadies) and shallow ponds.

MIGRATION - The deliberate movement of fish from one habitat to another. Includes both the upstream and downstream movement of young fish from rearing habitats to larger habitats (eg. lakes and the ocean) and adult fish to spawning habitats for reproduction.

NURSERY HABITAT - Refers generally to habitat used by juvenile life stages of fish for feeding, cover, growth, etc.

OBSTRUCTIONS (BARRIERS) - Instream features that prevent the upstream movement and migration of fish. These obstructions can be falls and rapids, beaver dams, log jams, etc. and can also include improperly placed culverts and bridges. Barriers can also include velocity barriers where the stream velocity is too great for fish to swim against. Determination of whether a barrier is passable to fish will depend upon the stream conditions at the time of migration, the species and size of fish, etc. and is best evaluated by professionals.

ORGANIC DEBRIS - Refers to all material in a stream that is of organic origin including algae, aquatic plants, trees, etc. as well as material from these sources. A distinction is often made between organic debris and large organic debris (see previous definition).

OVERHANGING COVER - Refers to cover provided by vegetation such as grasses, shrubs, alders, and other low story trees adjacent to the stream up to 1.0 meter above the water surface. This is distinguishable from canopy cover (see previous definition) provided by larger trees. It is most often expressed as a percentage of the stream area that is covered by overhanging vegetation.

POOLS - Habitat associated with water of considerable depth (> 50 cm) in relation to the average for the stream section. Pools generally have slow water and a smooth surface, but can be characterized by swift turbulent water flowing into and out of them. Substrate is often comprised of finer material as a result of the drop in stream velocity at pools.

POOL:RIFFLE RATIO - Refers to the ratio, as percentages, of pool and riffle type habitats in a stream reach or section. Habitat with good diversity is characterized by higher pool to riffle ratios.

PLUNGE POOL - Refers to the pool below a barrier or falls created by the erosive forces of water falling from the barrier. The presence and characteristics of a plunge pool is an important factor in the ability of fish to pass a given barrier.

RAPIDS - Habitat that is characterized by rapid, turbulent, shallow water with broken surface often with 'white' water flowing over coarse, large boulder/bedrock substrate. Most often associated with larger rivers and the higher gradient stretches of these systems and is analogous to riffle stretches in small streams.

RIFFLES - Habitat that is characterized by shallow water (< 25 cm) with moderate current with broken surface flow usually over gravel, cobble, rubble, and small boulder substrate. Excellent nursery habitat for juvenile salmonids.

RUNS - Habitat characterized by rapid current flow in a deep, narrow channel over a variety of substrate types. Flow is less turbulent than in riffles/rapids.

RUNOFF - Refers to the water that drains from the terrestrial confines of the watershed into the stream. Runoff amounts are determined by the amount of precipitation, evapotranspiration, temperature, soil permeability, groundwater sources, vegetation, etc.

SALMONID - Refers to a member of the fish family classed as Salmonidae and includes salmon, trout, char, whitefish and graylings. In Newfoundland and Labrador this includes the Atlantic salmon (Salmo salar), brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), rainbow trout (Oncorhynchus mykiss), lake trout (Salvelinus namaycush), arctic char (Salvelinus alpinus), lake whitefish (Coregonis clupeaformis), and round whitefish (Prosopium cylindracium).

SCOURING - Gradual or rapid erosion of material in the stream channel or flood plain by water and/or ice.

SEDIMENTATION - The deposition of material in the stream bed, primarily the finer materials (eg. clays, silt, sediment, sand, etc.) eroded from stream and its' watershed.

SPAWNING HABITAT - Refers to habitat used by reproductively active fish for spawning and incubation of fertilized eggs. For salmonids, this habitat is primarily a shallow stream section with moderate to strong water flow over the appropriate substrate (primarily cobbles and gravels of distinct size range) and is often associated with pool and riffle habitats.

STREAM BED - Refers to the portion of a stream that is covered by water (i.e. below the water surface). Some definitions of stream bed include all portions of the watershed that are covered by water at any time if the year.

STREAM ORDER - The location of a stream in the overall hierarchy of the drainage pattern of an entire river. A variety of numbering systems have been developed to assign stream order. First order (or primary) streams have no tributaries, second order streams have first order streams as tributaries, third order streams have second order tributaries, etc. Other designations assign stream order on the basis of size and some consideration of drainage pattern.

THALWEIG - The path of maximum water depth and flow in a stream channel. This path normally follows a meandering pattern back and forth across the channel.

TRANSECT - Refers to a sampling station established across a stream section, perpendicular to the flow, for the collection of measurements such as width, depth, bank height, velocity, substrate, and other physical stream characteristics.

TRIBUTARY - Refers to any stream that flows into another, larger stream above its confluence with salt water (river mouth). Any river can have many tributaries and a sequence or tributaries (see stream order).

TURBULENCE - The irregular motion or swirling pattern of water flow.

UNDERCUT BANKS - Habitat created by water scouring of the stream banks where the bank under the water surface is eroded. This is often located on stream margins on bends of rivers and in association with tree roots. This is excellent habitat for juvenile and adult salmonids.

VELOCITY (SURFACE, MEAN) - This is the speed, either at the water surface or at any point in the stream channel, of the water. Mean velocity can be the average for a stream cross section, for a section/station, or for the entire stream reach. Velocity is a function of discharge, width, depth, gradient and roughness of the bottom.

WALDRON'S RIVER CODE - A seven digit river code assigned by the Department of Fisheries and Oceans (see Waldron 1974).

WATERSHED - Refers to all of the terrestrial and aquatic components of a river's drainage pattern that receive precipitation and transport that precipitation to the stream. The boundaries of a river's drainage basin is determined by the surrounding topography which, in turn, determines the direction of runoff.

WIDTH (CHANNEL, WETTED) - The stream width is the perpendicular distance across a stream that is under water, i.e. from stream edge to stream edge. For streams with two or more channels, it is the sum of the wetted widths of all channels. Channel width refers to the distance across the stream from the top of one stream bank to the top of the opposite stream bank.

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APPENDIX 1

GENERIC STREAM SURVEY FORM

STREAM SURVEY FORM

1. LOCATION/GENERAL INFORMATION

Stream Name _____ River Code _____

Tributary of _____ Map Reference _____

Tributary No. _____ Section Number _____

Stream Order _____ Date(y/m/d) _____

Field Crew _____

Coordinates (lower) _____ (upper) _____

Weather _____ Time of Day _____

Description _____

_____

_____

_____

Comments: _____

_____

_____

_____

2. SECTION CHARACTERISTICS (GENERAL)

Section Length (m) _____ Water Level (l/m/h) _____

Water Temp. °C _____ Air Temp. °C _____ Water Sample (y/n) _____

Photos (y/n) _____ Roll # _____ Exposures _____

Width (m) Start _____ Middle _____ End _____ Mean _____

Surface Velocity ($m.s^{-1}$) 1 _____ 2 _____ 3 _____ Mean _____

3. **CROSS SECTIONS** (to be taken at Start, Middle, and End)

Detailed Transects (y/n) _____ (use separate sheet)

(i) Start (bottom) Check if same as end of last section _____

Location (m from start of section) _____

Channel Width (m) _____ Wetted Width (m) _____

Depth (cm) 1/4 _____ 1/2 _____ 3/4 _____ Mean _____

Bank Height (m) (Left) _____ (Right) _____

Ice Scour Height (m) (Left) _____ (Right) _____

(ii) Middle

Location (m from start of section) _____

Channel Width (m) _____ Wetted Width (m) _____

Depth (cm) 1/4 _____ 1/2 _____ 3/4 _____ Mean _____

Bank Height (m) (Left) _____ (Right) _____

Ice Scour Height (m) (Left) _____ (Right) _____

(iii) End

Location (m from start of section) _____

Channel Width (m) _____ Wetted Width (m) _____

Depth (cm) 1/4 _____ 1/2 _____ 3/4 _____ Mean _____

Bank Height (m) (Left) _____ (Right) _____

Ice Scour Height (m) (Left) _____ (Right) _____

4. HABITAT CHARACTERISTICS (GENERAL)

% Pool _____ % Riffle _____

% Run _____ % Steady _____

% Flat _____ % Rapids _____

% Other (falls, cascades, pond) _____

5. POOL CHARACTERISTICS

No. of pools _____ Pool/riffle ratio _____

Pool #	Length(m)	Width(m)	Depth(cm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Comments: _____

6. SUBSTRATE

	% of Section		% of Section
Bedrock	_____	Lg. Boulders (>1 m dia.)	_____
Sm. Boulders(25 cm-1 m)	_____	Rubble (14 - 25 cm)	_____
Cobble (6 - 13 cm)	_____	Pebble (3 - 5 cm)	_____
Gravel (20 mm - 3 cm)	_____	Sand (0.06 - 20 mm)	_____
Mud, Clay (0.004 - 0.05 mm)	_____		

Degree siltation (describe)_____

_____

_____

_____

_____

_____

7. COVER

	% Section	
Overhanging (riparian)	(y/n)_____	% of Section_____
Instream (large substrate, logs, debris, etc.)	(y/n)_____	% of Section_____
Instream (vegetation)	(y/n)_____	% of Section_____
Canopy cover	(y/n)_____	% of Section_____

8. RIPARIAN HABITAT

Vegetation:	Hardwood	(y/n)_____	% of Section_____
	Softwood	(y/n)_____	% of Section_____
	Alders, etc.	(y/n)_____	% of Section_____
	Shrubs	(y/n)_____	% of Section_____
	Grasses	(y/n)_____	% of Section_____
	Bog	(y/n)_____	% of Section_____

Stream bank:

Eroding Banks (y/n)_____ % of Section_____

Bank Stability (good/fair/poor)_____ _____

Undercut Banks (y/n)_____ Left Hand Bank (%)_____

Right Hand Bank (%)_____

9. OBSTRUCTIONS

Obstructions (y/n)_____ Type/Number_____

Vertical Height (m)_____ Slope (°)_____

Width (m)_____ Length (m)_____

Photos (y/n)_____ Roll #_____ Exposures_____

Comments:_____

_____

_____

_____

_____

(include sketch if possible, next page, with dimensions)

10. IMPROVEMENT OPPORTUNITIES

Comments:_____

_____

_____

_____

_____

_____

_____

_____

11. **SCHEMATIC SKETCH or DRAWING** (include location of cross-sections, pools, undercut and eroding banks, obstructions [in detail, separate drawing], springs, tributaries, and other points of interest and major landmarks, i.e. instream debris, siltation, culverts, sewer outfalls, etc.).

APPENDIX 2

GENERIC SUMMARY TABLES

Section Number	General Habitat Characteristics (%)					
	Pool	Riffle	Run	Steady	Falls	Other

Section Number	General Habitat Characteristics (%)					
	Pool	Riffle	Run	Steady	Falls	Other

Section Number	Bottom Substrate (%)							
	Bedrock	Large Boulder	Small Boulder	Rubble	Cobble	Gravel	Sand	Mud, etc.

Section Number	Cover Type (%)			
	Overhanging	Instream (debris, logs, etc.)	Instream (vegetation)	Canopy

Section Number	Riparian Vegetation (%)					
	Hardwood	Softwood	Alders	Shrubs	Grasses	Bog

Section Number	Bank Characteristics					
	Bank Erosion			Undercut Banks		
	y/n	% of Section	Stability	y/n	Left Bank (%)	Right Bank (%)

APPENDIX 3

LIST OF DEPARTMENT OF FISHERIES AND OCEANS CONTACTS

List of the Department of Fisheries and Oceans Contacts.

There are two groups within DFO that are primarily responsible for providing advice and support for publically sponsored small stream improvement and enhancement projects in Newfoundland and Labrador. These include the Habitat Management Division (HMD), Fisheries and Habitat Management Branch (FHMB) and the Salmonid and Habitat Sciences Division (SHSD), Science Branch (SB) including both the Enhancement and Aquaculture Section (EAS) and the Habitat Research and Assessment Section (HRAS). The Habitat Management Division has the primary responsibility for planning of habitat improvement projects, for assisting groups in procuring funding for these initiatives, and for providing permits for activities that may be conducted in fish habitat through the Fish Habitat Authorization system. The Salmonid and Habitat Sciences Division has the lead responsibility for technical support for habitat improvement projects that have received funding (EAS lead, HRAS support) and for development, support and implementation of enhancement initiatives (EAS). Research in support of a regional habitat improvement program and for selected projects is the primary responsibility of HRAS (support from EAS). These groups work together to provide comprehensive support for public groups in relation to planning, delivery, and research for a habitat improvement and enhancement program within the Newfoundland Region (see Figure A4-1). Support for projects implemented in the DFO Gulf Region (Fig. A4-1) is provided through contacts in Area office in Corner Brook from both the Fisheries and Habitat Management Division and Science Branch. Selected contacts within DFO are provided below.

Newfoundland Region

Fisheries and Habitat Management Branch
Habitat Management Division
Planning and Inventory Section
Section Head
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2852

Fisheries and Habitat Management Branch
Habitat Management Division
Habitat Evaluation Section
Habitat Evaluation Engineer
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2852

Fisheries and Habitat Management Branch
Habitat Management Division
Area Habitat Coordinator
P.O. Box 970
St. John's, Newfoundland
A1C 5M3
(709) 772-5044

Fisheries and Habitat Management Branch
Habitat Management Division
Area Habitat Coordinator
P.O. Box 459
Grand Falls, Newfoundland
A2A 2J8
(709) 292-5170

Science Branch
Salmonid and Habitat Sciences Division
Enhancement and Aquaculture Section
Senior Salmon Development Biologist
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2128

Science Branch
Salmonid and Habitat Sciences Division
Enhancement and Aquaculture Section
Senior Engineer
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2842

Fisheries and Habitat Management Branch
Habitat Management Division
Area Habitat Coordinator
P.O. Box 580
Grand Bank, Newfoundland
A0E 1W0
(709) 832-0010

Fisheries and Habitat Management Branch
Habitat Management Division
Area Habitat Coordinator
P.O. Box 7003, Station A
Goose Bay, Labrador
A0P 1S0
(709) 896- 2924

Science Branch
Salmonid and Habitat Sciences Division
Enhancement and Aquaculture Section
Public Involvement Technician
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2862

Science Branch
Salmonid and Habitat Sciences Division
Habitat Research and Assessment Section
Section Head
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2007

Science Branch
Salmonid and Habitat Sciences Division
Habitat Research and Assessment Section
Senior Habitat Technician
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-4341

Science Branch
Salmonid and Habitat Sciences Division
Habitat Research and Assessment Section
Freshwater Habitat Research Biologist
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1
(709) 772-2007

Gulf Region

Fisheries and Habitat Management Branch
Habitat Management Division
Area Habitat Coordinator
P.O. Box 2009
Corner Brook, Newfoundland
A2H 6Z6
(709) 637-1421

Science Branch
Salmon Enhancement Biologist
P.O. Box 2009
Corner Brook, Newfoundland
A2H 6Z6
(709) 637-1421